

CLAIMS

What is Claimed is:

1. A vapor generator comprising:
 - a combustion chamber;
 - an outer structure surrounding the combustion chamber, wherein a cavity is located between the combustion chamber and the outer structure;
 - a water inlet located in the outer structure, wherein the water inlet is configured to receive water into the cavity;
 - a water injection element configured to introduce water to the combustion chamber;
 - a water conduit coupling the cavity to the water injection element, wherein the water conduit is configured to transfer water from the cavity to the water injector element.
2. The vapor generator of Claim 1, wherein the combustion chamber comprises a first cylindrical element and the outer structure comprises a second cylindrical element, wherein the cavity is located between the first and second cylindrical elements.
3. The vapor generator of Claim 2, wherein the first and second cylindrical elements are tapered at each end.
4. The vapor generator of Claim 3, further comprising:
 - a first connector element joining first ends of the first and second cylindrical elements, wherein the

combustion chamber is exposed through an opening in the first connector element; and

a second connector element joining second ends of the first and second cylindrical elements, wherein the combustion chamber is exposed through an opening in the second connector element.

5. The vapor generator of Claim 1, further comprising:

an ignition inlet extending into the combustion chamber, wherein the ignition inlet is configured to receive an ignition element for introducing sparks to the combustion chamber;

a fuel inlet extending into in the combustion chamber, wherein the fuel inlet is configured to receive fuel into the combustion chamber; and

an air inlet extending into the combustion chamber, wherein the air inlet is configured to receive air from a blower unit; and

a vapor outlet extending out of the combustion chamber, wherein the vapor outlet is configured to provide vapor exhaust from the combustion chamber.

6. The vapor generator of Claim 5, further comprising a baffle element coupled to the air inlet, wherein the baffle element shields the ignition inlet and the fuel inlet from the air inlet.

7. A method of generating water vapor, comprising:
introducing water to a cavity that surrounds a combustion chamber;

routing the water from the cavity into the combustion chamber through a water injection element; introducing fuel, sparks and an air flow into the combustion chamber, whereby the sparks ignite the fuel and air, mixture, thereby heating the water in the combustion chamber to create water vapor, and pre-heating the water in the cavity surrounding the combustion chamber.

8. The method of Claim 7, further comprising introducing the air flow into the combustion chamber through a baffle.

9. The method of Claim 7, wherein the air flow is introduced at a rate in the range of about 300 to 400 cubic feet per minute (cfpm) at a maximum pressure in the range of about 3 to 5 pounds/square inch (psi).

10. A soil remediation unit comprising:
a vapor generator configured to generate vapor;
a vapor tube coupled to receive the vapor from the vapor generator, the vapor tube having one or more openings for emitting the vapor;
a soil tube that surrounds the vapor tube, wherein the soil tube includes a first end configured to receive soil and a second end configured to expel soil;
a drive assembly coupled to the cylindrical soil tube, wherein the drive assembly is configured to rotate the cylindrical soil tube; and
one or more lift paddles located in the soil tube, wherein the one or more lift paddles are configured to

move soil through the soil tube as the soil tube rotates.

11. The soil remediation unit of Claim 10, further comprising a motor coupled to the drive assembly.

12. The soil remediation unit of Claim 10, wherein the drive assembly comprises:

a first rotating gear element mounted on a platform; and

a second gear element located on an exterior surface of the soil tube, wherein the first rotating gear element engages the second rotating gear element; and

a motor coupled to drive the first rotating gear element.

13. The soil remediation unit of Claim 12, further comprising one or more rotating support elements mounted on the platform, wherein the one or more rotating support elements support and facilitate the rotation of the soil tube.

14. The soil remediation unit of Claim 13, further comprising one or more wear rings located on the exterior surface of the soil tube, wherein the one or more wear rings engage the one or more rotating support elements.

15. The soil remediation unit of Claim 10, further comprising a covered return path that returns vapor emitted from the vapor tube to the vapor generator.

16. The soil remediation unit of Claim 10, wherein the vapor tube is thermally conductive, whereby the vapor heats the vapor tube.

17. The soil remediation unit of Claim 10, wherein the one or more openings emit vapor along the length of the vapor tube.

18. The soil remediation unit of Claim 10, wherein ends of the vapor tube are held stationary by two support structures.

19. The soil remediation unit of Claim 10, wherein the one or more openings are configured to face downward.

20. The soil remediation unit of Claim 10, wherein the soil tube has a diameter in the range of about 20 to 40 inches.

21. The soil remediation unit of Claim 10, further comprising a portable platform, wherein the vapor tube, soil tube and drive assembly are all located on the portable platform.

22. The soil remediation unit of Claim 21, wherein the vapor generator is located on the portable platform.

23. The soil remediation unit of Claim 22, wherein the portable platform is a trailer or a truck bed.

24. The soil remediation unit of Claim 10, further comprising a soil input chute for directing soil into the first end of the soil tube.

25. The soil remediation unit of Claim 10, further comprising a soil output chute for directing soil out of the second end of the soil tube.

26. The soil remediation unit of Claim 10, wherein each of the one or more lifting paddles exhibits a spiral pattern along the length of the soil tube.

27. The soil remediation unit of Claim 10, wherein each of the one or more lifting paddles exhibits a flanged end.

28. The soil remediation unit of Claim 10, wherein each of the one or more lifting paddles is configured to lift and drop soil directly on the vapor tube.

29. A method of decontaminating contaminated soil, the method comprising:

- generating high-temperature water vapor;
- forcing the water vapor into a thermally conductive vapor tube having one or more openings for emitting the vapor, whereby the water vapor heats the vapor tube;
- introducing contaminated soil to one end of the soil tube, wherein the soil tube laterally surrounds the vapor tube;

rotating the soil tube around the vapor tube, thereby forcing the contaminated soil into contact with the vapor tube and decontaminating the soil.

30. The method of Claim 29, further comprising using one or more lifting paddles on the interior of the soil tube to facilitate the movement of the soil through the soil tube.

31. The method of Claim 29, wherein the high temperature water vapor has a temperature of at least about 800 degrees F.

32. The method of Claim 29, wherein the vapor tube reaches a temperature of at least about 1000 degrees F.

33. The method of Claim 29, wherein the step of rotating the soil tube causes soil to be expelled from a second end of the soil tube.

34. The method of Claim 29, further comprising using gasses from within the soil tube to generate the high temperature water vapor.